or first floors or uses fresh water to flood those areas to counteract floodwater pressure and prevent the intrusion of sediment-laden floodwaters. Wet floodproofing is designed mainly to protect the structural integrity of a building by permitting damage to electrical systems, building contents and interior walls. Measures must be taken to permit rapid removal or floodproofing of machinery, materials, and other damageable contents. Although conceptually sound, flooding a building to equalize interior and exterior pressures requires careful application and continuous monitoring of the rate at which internal and external flooding takes place in order to prevent structural damage. In addition, if water free of sediment and other pollutants is to be used for intentional flooding, a continuous source of fresh water must be available.

Federal Subsidies that Undermine Floodplain Regulations

Federally subsidized flood insurance and the standards of the NFIP have encouraged state and local adoption of floodplain regulations, but may also have encouraged floodplain development.[28] Federal funding of flood control works with an 80% to 100% federal subsidy also encourages development and discourages nonstructural flood loss reduction techniques which shift loss-bearing to the floodplain occupant. Development is also supported by federal principles and standards for flood control measures which permit the Corps and other agencies to include the highest intensity future floodplain uses as economically feasible elements in the cost/benefit analyses. At the same time, limited or no benefits can be claimed for open space use or maintenance of natural resources. Many of the aggressive floodplain management programs that incorporated regulations and other elements were developed by communities during the 1970s only after federal agencies rejected structural solutions due to problems with soils, topography, or unfavorable cost/benefit ratios.[29]

Regulations Combined with Other Techniques

Many communities and some states combined regulations with other management techniques to reduce future flood losses, provide areas for public use, and accomplish broader floodplain management and land use objectives.

Acquisition

An estimated several thousand communities acquired a portion of their floodplains for park, parkway, wildlife, conservation, agricultural, or other environmental or social uses.[30] Acquisition complements regulations by providing total protection for critical environmental areas such as habitat for threatened and endangered species. It also makes the land available to the public for hiking, picnicking, or other recreational purposes.

Acquisition is more permanent than regulations--once completed it is not so subject to the whim of local legislative bodies. However, it is costly if the purchase is made in fee. Typical floodplain acquisition costs in rural areas range from $300 to $1,000 an acre. Urban costs often range from $1;000 upward, depending on a wide range of variables.

Localities have acquired the most land and have held it in fee. However, some communities such as Glastonbury, Connecticut, and East Hampton, New York, have acquired easements to reduce costs, continue lands on the tax rolls, and avoid maintenance responsibilities. Private donations of land as gifts or bequests have also been important, particularly for wetlands.

Most acquisition has been voluntary although a few communities have used eminent domain powers. Local governments have frequently used federal funding sources such as the Department of Interior's Land and Water Conservation Fund and HUD's Community Development Block Grant Program to help pay acquisition costs. State funding sources such as

the New Jersey Green Acres Program have also played important roles in a few states.

- Milwaukee County, Wisconsin, acquired most of the county's floodplain as well as its Lake Michigan bluff area for part of its greenway and park corridor system. Milwaukee was one of the first cities in the nation to regulate floodplains, starting in 1936. Acquisition was also begun in the 1930s.

- Sacramento County, California, combined regulations and acquisition to protect the floodplain and provide public recreation areas along much of the county's American River floodplain. Altogether, the city, county, and private organizations have acquired about 3,000 acres along 23 miles of river. A variety of state, local, and private funding sources were used.

- Scottsdale, Arizona, acquired a 4.6 mile-long greenbelt floodway along Indian Bend Wash which runs through the city. A bond issue and the Corps provided the funding.

- In cooperation with the Twin Cities Metropolitan Council, Ramsey County, Minnesota, has acquired much of the Mississippi River floodplain in the town of Lilydale. An estimated $4.4 million in project funding was provided by local and metropolitan sources.

- Dallas, Texas, acquired more than 2,500 acres of floodplain along the Elm Fork of the Trinity River and Oak Creek at an estimated total price of $4.5 million. Funding was from a variety of sources, including local bond issues, the Land and Water Conservation Fund, and HUD open space programs. Some of the floodplain was privately donated to the city.

- The Brandywine Conservancy (a private, nonprofit Pennsylvania corporation) acquired 400 acres in fee and 4,000 acres of easements for critical environmental areas in 20 communities since 1967. Much of the acquired land is floodplain along the Brandywine River. Negotiation with landowners and limited purchase has been applied.

State and federal authorities have also acquired floodplain areas, but on a more limited scale. For example, the Corps of Engineers is purchasing 8,500 acres of floodplain wetlands along the Charles River near Boston to preserve valley storage and prevent increased flood heights in the Boston area. The Corps and the state have agreed that other flood storage areas along the Charles will be regulated by local governments.

Floodplain subject to conservation easement, Black Earth Creek, Wisconsin.

Photo by Jon Kusler.

Regulations and Public Facilities Planning

In the 1970s, all levels of government made progress in applying flood hazard mitigation policies to new public infrastructure--roads, sewers, bridges, water supply systems, electric lines and natural gas pipelines. These facilities are not only subject to costly flood damages but influence the location and intensity of private floodplain development. State and local governments have long had the authority to refuse or limit infrastructure in floodplain areas because of their high costs and the threat of recurrent flood damages. Until recently, however, few have done so because of pressure from landowners and lack of coordination between regulatory and public works programs.

The federal executive orders on floodplain management and protection of wetlands issued in 1977 and the NFIP standards pertaining to public uses gave impetus to state and local initiatives. The orders require that federal projects and federally funded state and local projects be located outside the floodplain, unless no alternative exists. If none exists, early notice must be provided to the public and measures must be taken to minimize flood damages and harm to natural values.

Federal agencies are now in the process of implementing these orders. They are reviewing and revising earlier policies for extending facilities into floodplain areas. For example, the Environmental Protection Agency conditioned a sewer grant to Cape May, New Jersey on an agreement that they would limit sewer extensions in flood hazard areas.

Some state statutes and executive orders require control of public works in floodplain areas. The NFIP has required states to control public buildings in order to qualify for flood insurance. In response many states have adopted executive orders.[31] Other states like New Jersey directly regulate state and local public works under floodplain regula-

tory statutes. Several states regulate public uses in specific hazard areas through coastal zone management statutes or executive orders. For example, in August 1980, Governor King of Massachusetts issued a beach and barrier island executive order prohibiting new construction in front of the dunes on barrier beaches and denying state aid for such activities, including rebuilding of existing structures.[32]

Regulations and Flood Warning Signs

Some states and communities have erected flood warning signs to complement regulations. A single sign along a heavily traveled highway can do much to raise community awareness. Flash flood warning signs are used in Boulder, Colorado, and other Rocky Mountain front range communities. Warning signs have also been adopted by some coastal communities such as Shelter Island, New York. Signs that warn of the flooding threat and give flood heights and dates of past flood events are particularly effective.

Regulations and Tax Incentives

Real estate and other tax incentives have been combined with regulations to encourage open space uses. For example, the New Jersey state floodplain regulatory statute requires that local property tax assessors consider state regulations.[33] A Massachusetts statute authorizes reduced property taxation for landowners who execute conservation restrictions for floodplains, wetlands, or other similar areas.[34]

At least 43 states offer broad real estate tax incentive programs for lands in agriculture, forestry, and certain other open space uses.[35] Undeveloped floodplains may qualify for reduced taxation pursuant to many of these statutes. Under most statutes, lands entered into programs are assessed at open space value rather than potential development value. If owners subsequently decide to develop the land, they usually must pay taxes (calculated at full development potential) plus interest and, in

some instances, a penalty. Despite widespread adoption, open space tax provisions have been only partially successful since many landowners wish to hold their lands in an open condition only temporarily.

California has experimented most extensively with open space tax incentives for agricultural and other open space lands.[36] In this state, lands must be both entered into the open space taxation program and regulated prior to receipt of benefits. Other states with active programs are Maryland, Minnesota, Vermont, and Wisconsin.

Federal and, to some extent state, income tax laws also encourage open space protection. Individuals who donate such lands or open space easements to government units or private nonprofit corporations may deduct the value of the contributions from ordinary income as "charitable contributions."[37] Under present federal tax laws, an individual may deduct up to 30% of adjusted gross income in a tax year, with carryover deductions in the succeeding five years.

Private donations to receive income tax deductions are particularly attractive if a parcel of land has substantially appreciated since original purchase or development is contrary to regulations or considered inadvisable by the individual or corporation. The value of the charitable contribution is the present full market value of the land. For an individual or corporation with substantial income, it may be more profitable to donate than to sell floodplain parcels.

Regulations and Public Education

Public education has been essential to developing and implementing floodplain management programs. Education during the 1970s has included distribution of flood maps and brochures; workshops and training sessions; marking flood hazard areas; and one-to-one discussions with floodplain property owners, insurance agents, lenders, lawyers, and others involved in floodplain decision making. State floodplain management programs